MIT International Center for Air Transportation

Interactive Electronic Flight Strips

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Agenda

- Motivation
- Design Process
- Current Design and Sample Scenario
- Unresolved Issues, Current Progress, and Future Work

Motivation

- **Controller interface needed for MIT departure planner**
- **System architecture and design driven by requirements analysis**
  - ☐ Functional (controller input-output)
  - ☐ Human factors

DP Interface
Functional Requirements

- **Controller Input**
  - ☐ Aircraft “ready to push” time
  - ☐ Aircraft push time
  - ☐ Aircraft taxi start time
  - ☐ Aircraft takeoff time
  - ☐ Aircraft gate location
  - ☐ Current runway configuration
  - ☐ Downstream constraints
- **Controller Output**
  - ☐ Suggested runway configuration changes (configuration manager)
  - ☐ Pushback queue and initial runway assignments (gate manager)
  - ☐ Virtual runway queue and takeoff times (virtual queue and mix managers)
- **All other DP input from static databases (e.g., airport layout) or other sources (e.g., weather forecasts, host, surface surveillance)**

DP Interface
Human Factors Requirements

- Minimize head-down time
- Maintain mobility within tower cab

Observations

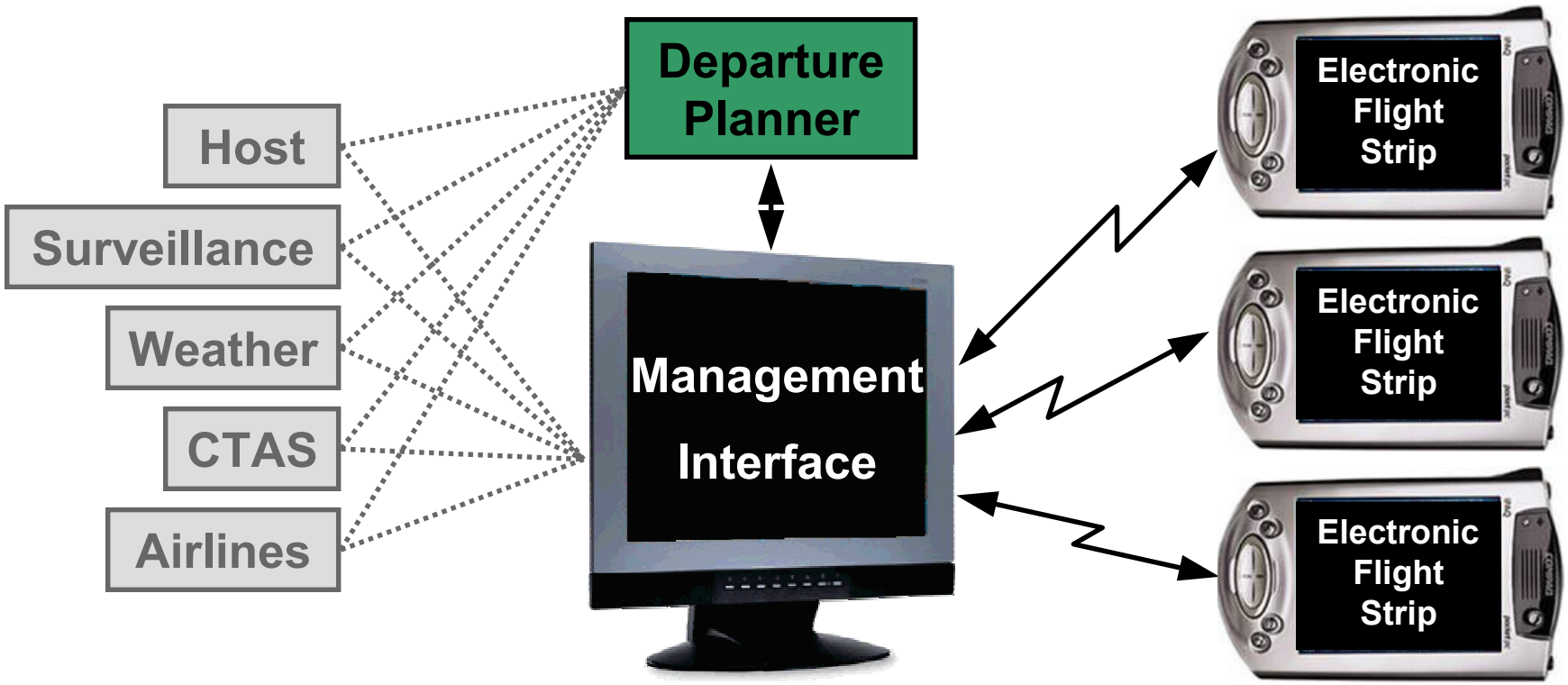
- **Some DP inputs already written on paper flight strips**
  - ☐ “Ready to push” time
  - ☐ Actual push time (if different from “Ready to push”)
  - ☐ Takeoff time
- **Some aircraft-specific DP inputs would be easy to add to a flight strip**
  - ☐ Taxi start time
  - ☐ Gate location

- **Other DP inputs and outputs better suited to centralized interface**
  - ☐ Current runway configuration
  - ☐ Suggested runway configuration changes
  - ☐ Downstream restrictions
  - ☐ Runway, Taxi, and Push queues

System Architecture Conclusions

- **To satisfy all interface functional requirements**
  - Electronic flight strip system
  - Central management interface
- **To satisfy human factors requirements of tower environment**
  - An electronic analogue of the individual paper flight progress strip is needed, not just an electronic analogue of the strip rack
- **Solution: PDA-based electronic flight strips communicating over wireless LAN with desktop-based central management interface**

System Architecture



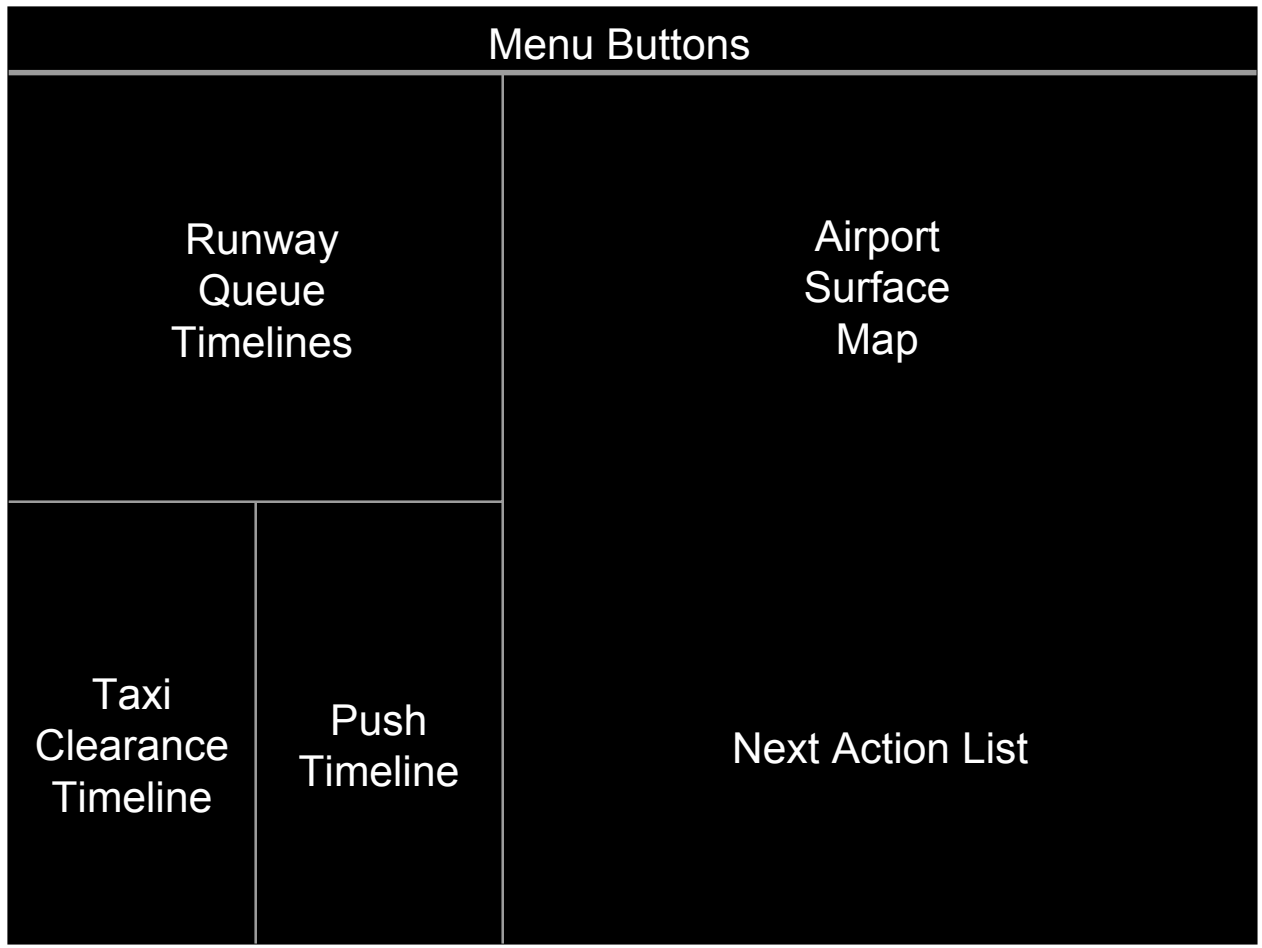
- One electronic device per flight strip

Design Considerations

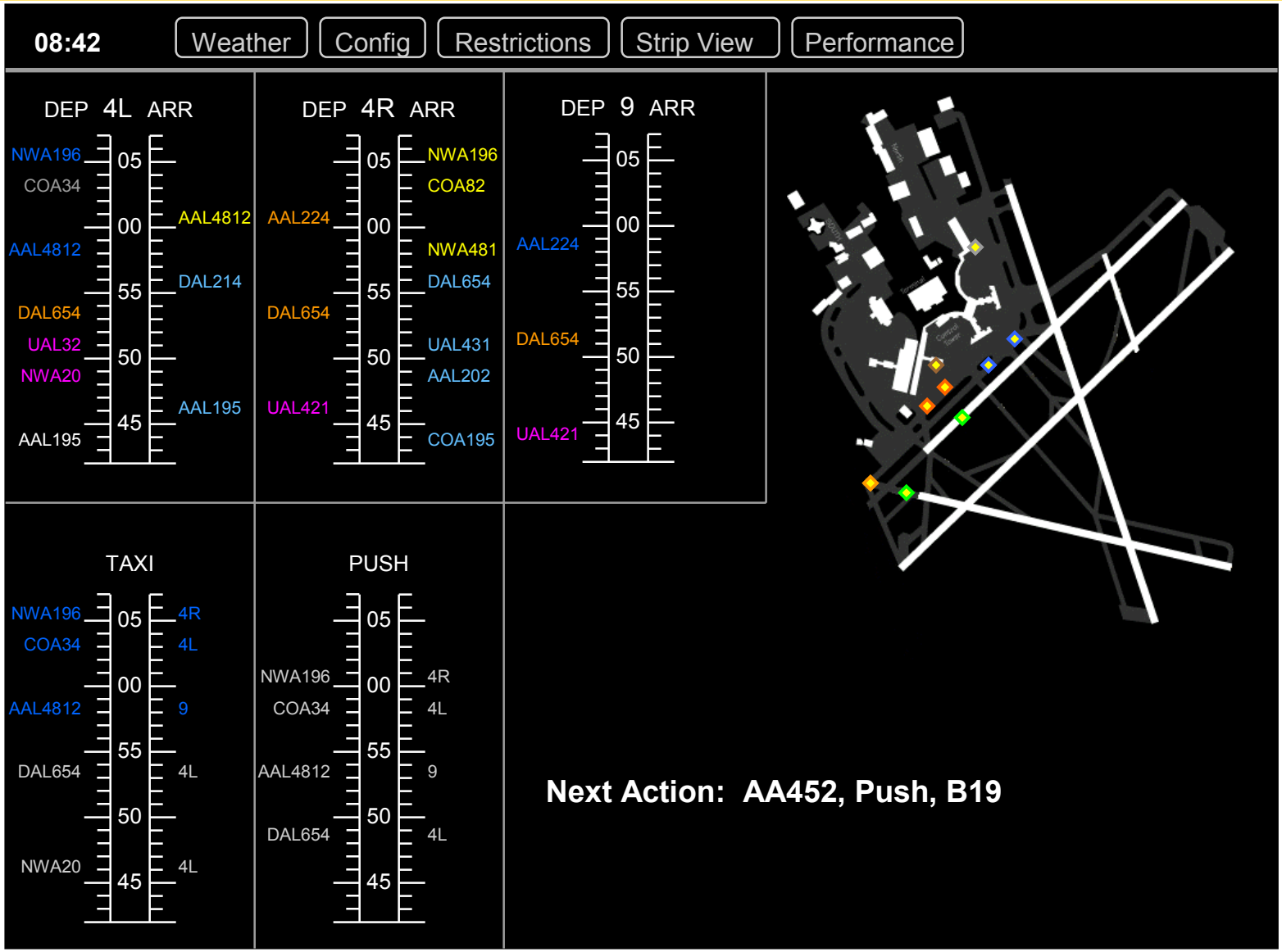
- **Electronic flight strip must preserve functionality present in current paper departure flight strips (source: BOS Tower SOP)**
  - ☐ Changing aircraft type, altitude, route, etc.
  - ☐ Recording initial heading
  - ☐ Recording ready to push and departure times
  - ☐ Recording in-trail restrictions
  - ☐ Recording nonstandard taxi paths
  - ☐ Indicating wake turbulence waiver
  - ☐ Indicating ATIS received by aircraft
  - ☐ Indicating position and hold clearance issued
  - ☐ Writing any other nonstandard instructions
- **Other aspects of paper flight strips and strip rack that should be preserved**
  - ☐ Handoffs completed by physically transferring strip from controller to controller
  - ☐ Ability to sort flights in strip rack

Management Interface: General Layout

- **Management interface provides airport-centric view of operations**



Management Interface



Flight Strip: General Layout

- **Electronic flight strip shows paper flight strip data and aircraft-centric view of operations**

Flight Strip: Example Screen

Color Coding

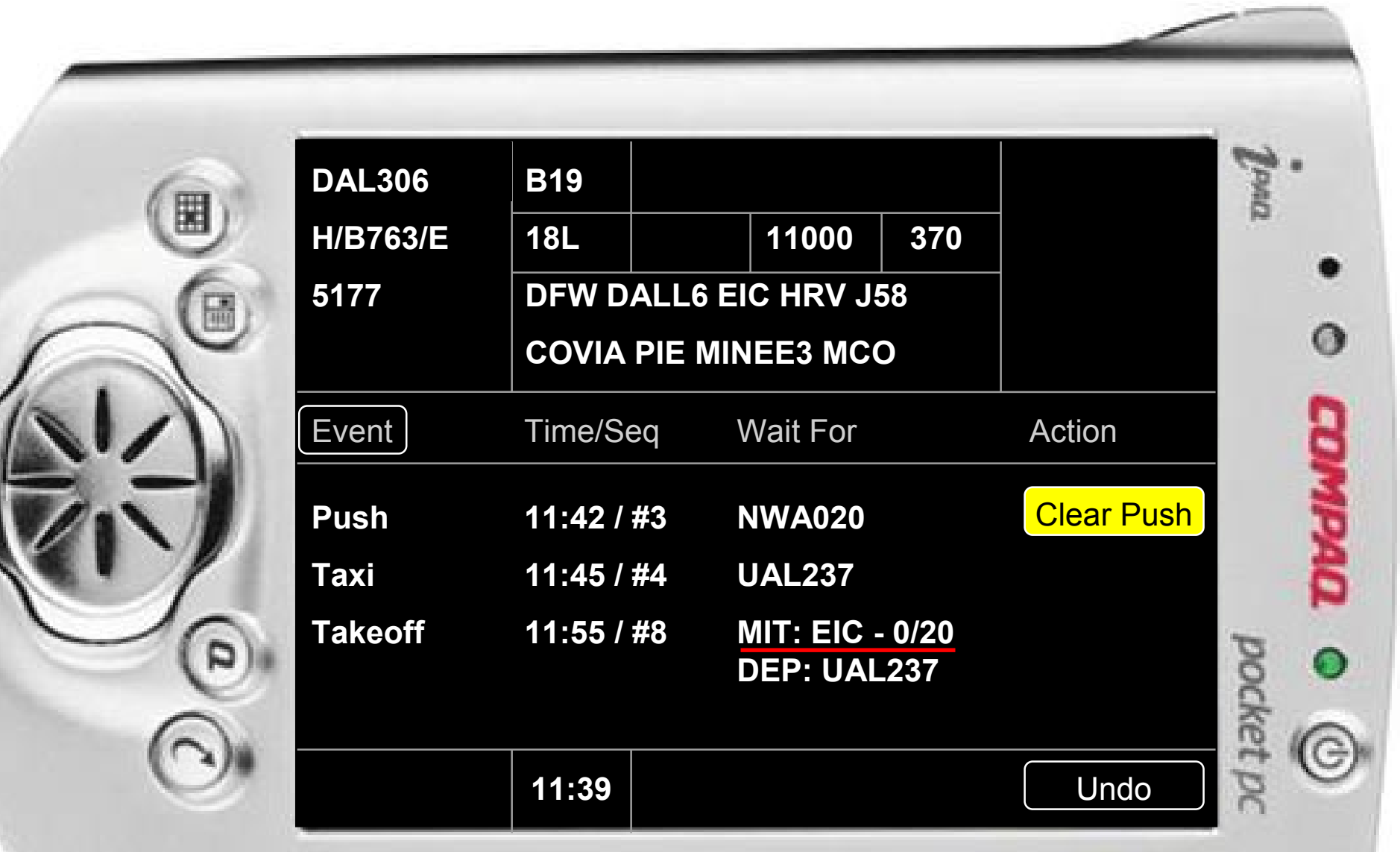
- **Callsign**
  - ☐ No clearance — DAL306
  - ☐ Cleared for push — DAL306
  - ☐ Cleared for taxi to runway — DAL306
  - ☐ Cleared for taxi with hold short point — DAL306
  - ☐ Cleared for position and hold — DAL306
  - ☐ Cleared for takeoff — DAL306
- **Clearance Buttons**
  - ☐ "Wait For" event not yet occurred — Taxi 18L
  - ☐ All "Wait For" events occurred — Taxi 18L
- **Critical "Wait For" event**
  - ☐ Underlined in red — MIT: EIC 5/20

Interactivity

- **Controller – Management Interface**
  - Drag and drop aircraft on timelines to resequence
- **Controller – Flight Strip**
  - To change altitude, heading, runway, etc: tap box, choose from pop-up list of choices, or scroll through possible choices with up/down hardware buttons, then tap “accept” or “cancel” soft buttons
  - To issue clearance: tap clearance soft button
  - To undo last clearance: tap “undo” soft button
  - To view full event history: hold stylus over “events” soft button
- **Management Interface – Flight Strip**
  - When flight strip is picked up / hardware button pressed, aircraft is highlighted on map display and management interface timelines
  - When aircraft is selected on management interface, flight strip is highlighted in some way (reverse video, flashing screen, etc.)

Flight Strip: Aircraft at Gate

Flight Strip: Aircraft Ready to Push



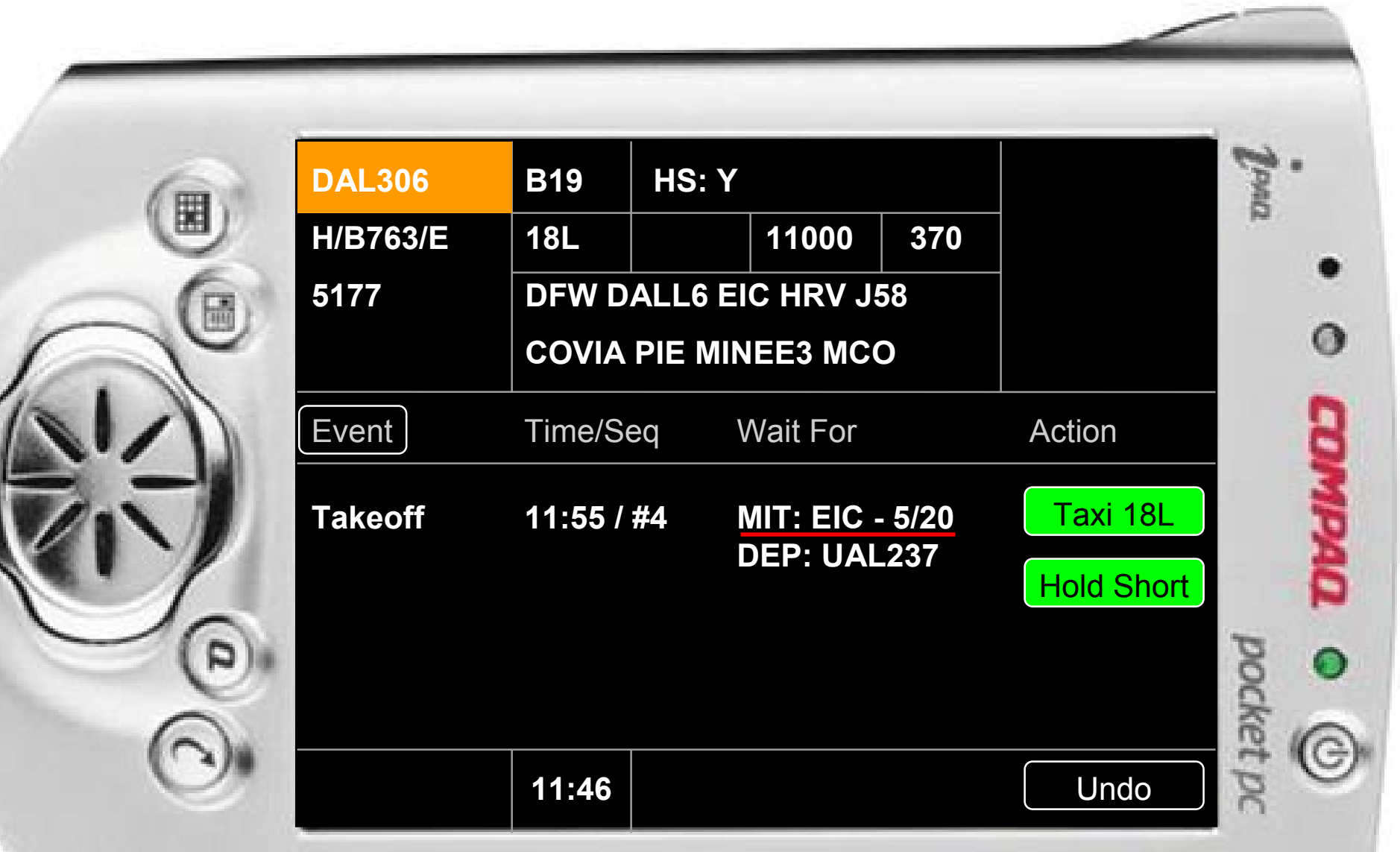
Flight Strip: Aircraft #1 for Push

Flight Strip: Aircraft Pushed

Flight Strip: Aircraft #1 for Taxi

Flight Strip: Selecting Hold Short Point

Flight Strip: Aircraft at Hold Short Point



Flight Strip: Aircraft Taxiing

Flight Strip: Aircraft #1 for Takeoff, Waiting for Departure Aircraft

Flight Strip: Aircraft #1 for Takeoff, Initial Heading Selection

Unresolved Issues

- **Sequence-based vs. time-based planning**
- **Absolute vs. differential time**
- **Color conventions**
- **What is the important information to show for each “Wait For” event**
  - ☐ EDCT
  - ☐ DSP
  - ☐ APREQ
  - ☐ MIT
  - ☐ MINIT
  - ☐ Aircraft to Follow

Current Progress

- **Application running on PDAs showing current design with partial functionality**
  - ☐ Displays flight strip data
  - ☐ Heading and altitude can be modified
  - ☐ Sends data over wireless LAN to management interface

Future Work

- Finish coding initial design of flight strips and management interface
- Solicit input on interface from Boston Logan controllers
- Revise design based on controller input
- Evaluate controller performance with electronic flight strips